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International Bureau

INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

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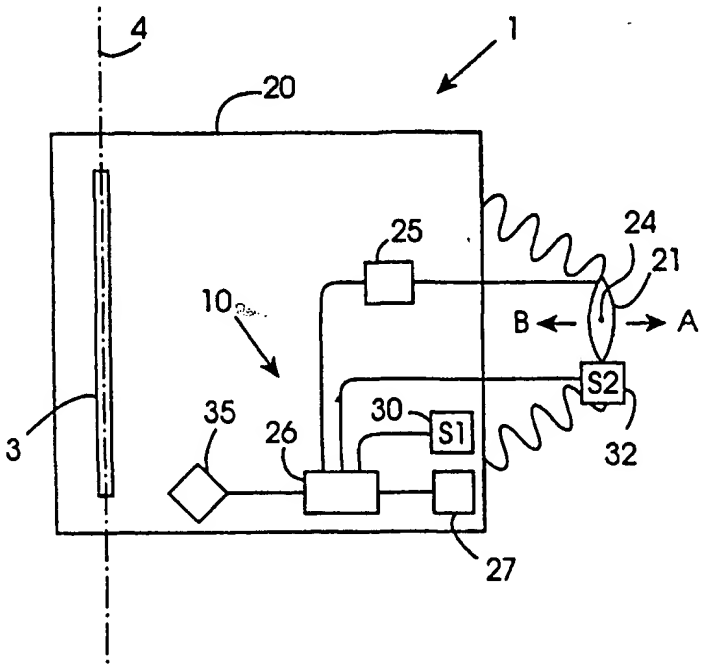
**Published**
*With international search report.*

(54) Title: A METHOD AND APPARATUS FOR FACILITATING A DETERMINATION OF A LINEAR DIMENSION OF AN OBJECT FROM AN IMAGE OF THE OBJECT

(57) Abstract

A camera (1) comprises a microprocessor (26) which controls a light projector (35) for projecting a measuring scale (12) having graduations (15) onto two peripheral edges (17 and 18) of a film (3) in an image plane (4). The microprocessor (26) determines the magnification (positive or negative) of an image (2) formed on the film (3) relative to the object from which the image (2) is formed, and the spacing between the graduations (15) corresponds to the number of metric units represented by the spacing between the graduations (15) and the magnification of the image (2) so that when a print is made on photographic paper the linear dimensions of the image in the plane of the photographic paper can readily be read directly from the measuring scales which are formed on the photograph which correspond to the measuring scales (12). The dimensions read from the measuring scale (12) are the actual dimensions of the object.



# PCT NT COOPERATION TREAT

From the INTERNATIONAL BUREAU

## PCT

### NOTIFICATION OF ELECTION

(PCT Rule 61.2)

To:

Commissioner
US Department of Commerce
United States Patent and Trademark
Office, PCT
2011 South Clark Place Room
CP2/5C24
Arlington, VA 22202
ETATS-UNIS D'AMERIQUE

in its capacity as elected Office

| | |
|---|---|
| **Date of mailing** (day/month/year)<br>21 November 2000 (21.11.00) | |
| **International application No.**<br>PCT/IE00/00037 | **Applicant's or agent's file reference**<br>PE1115 |
| **International filing date** (day/month/year)<br>03 April 2000 (03.04.00) | **Priority date** (day/month/year)<br>01 April 1999 (01.04.99) |
| **Applicant**<br>MONTAUT, Brian, Emile | |

1. The designated Office is hereby notified of its election made:

[X] in the demand filed with the International Preliminary Examining Authority on:

24 October 2000 (24.10.00)

[ ] in a notice effecting later election filed with the International Bureau on:

2. The election [X] was

[ ] was not

made before the expiration of 19 months from the priority date or, where Rule 32 applies, within the time limit under Rule 32.2(b).

| | |
|---|---|
| **The International Bureau of WIPO**<br>**34, chemin des Colombettes**<br>**1211 Geneva 20, Switzerland** | Authorized officer<br>Pascal Piriou |
| Facsimile No.: (41-22) 740.14.35 | Telephone No.: (41-22) 338.83.38 |

# PATENT COOPERATION TREATY

# PCT

REC'D 06 JUL 2001
WIPO PCT

## INTERNATIONAL PRELIMINARY EXAMINATION REPORT

(PCT Article 36 and Rule 70)

14

| Applicant's or agent's file reference | FOR FURTHER ACTION | See Notification of Transmittal of International Preliminary Examination Report (Form PCT/IPEA/416) |
|---|---|---|
| PE1115 | | |
| International application No. | International filing date *(day/month/year)* | Priority date *(day/month/year)* |
| PCT/IE00/00037 | 03/04/2000 | 01/04/1999 |
| International Patent Classification (IPC) or national classification and IPC<br>G01B11/00 | | |
| Applicant<br>MONTAUT, Brian, Emile | | |

1. This international preliminary examination report has been prepared by this International Preliminary Examining Authority and is transmitted to the applicant according to Article 36.

2. This REPORT consists of a total of 12 sheets, including this cover sheet.

   ☐ This report is also accompanied by ANNEXES, i.e. sheets of the description, claims and/or drawings which have been amended and are the basis for this report and/or sheets containing rectifications made before this Authority (see Rule 70.16 and Section 607 of the Administrative Instructions under the PCT).

   These annexes consist of a total of sheets.

3. This report contains indications relating to the following items:

   - I ☒ Basis of the report
   - II ☐ Priority
   - III ☐ Non-establishment of opinion with regard to novelty, inventive step and industrial applicability
   - IV ☐ Lack of unity of invention
   - V ☒ Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations suporting such statement
   - VI ☐ Certain documents cited
   - VII ☒ Certain defects in the international application
   - VIII ☐ Certain observations on the international application

| Date of submission of the demand | Date of completion of this report |
|---|---|
| 24/10/2000 | 04.07.2001 |
| Name and mailing address of the international preliminary examining authority:<br>European Patent Office<br>D-80298 Munich<br>Tel. +49 89 2399 - 0 Tx: 523656 epmu d<br>Fax: +49 89 2399 - 4465 | Authorized officer<br>Dighaye, J-L<br>Telephone No. +49 89 2399 2823 |

Form PCT/IPEA/409 (cover sheet) (January 1994)

# INTERNATIONAL PRELIMINARY EXAMINATION REPORT

International application No. PCT/IE00/00037

## I. Basis of the report

1. With regard to the **elements** of the international application *(Replacement sheets which have been furnished to the receiving Office in response to an invitation under Article 14 are referred to in this report as "originally filed" and are not annexed to this report since they do not contain amendments (Rules 70.16 and 70.17))*:
**Description, pages:**

1-20 as originally filed

**Claims, No.:**

1-105 as originally filed

**Drawings, sheets:**

1/2-2/2 as originally filed

2. With regard to the **language**, all the elements marked above were available or furnished to this Authority in the language in which the international application was filed, unless otherwise indicated under this item.

These elements were available or furnished to this Authority in the following language: , which is:

- ☐ the language of a translation furnished for the purposes of the international search (under Rule 23.1(b)).
- ☐ the language of publication of the international application (under Rule 48.3(b)).
- ☐ the language of a translation furnished for the purposes of international preliminary examination (under Rule 55.2 and/or 55.3).

3. With regard to any **nucleotide and/or amino acid sequence** disclosed in the international application, the international preliminary examination was carried out on the basis of the sequence listing:

- ☐ contained in the international application in written form.
- ☐ filed together with the international application in computer readable form.
- ☐ furnished subsequently to this Authority in written form.
- ☐ furnished subsequently to this Authority in computer readable form.
- ☐ The statement that the subsequently furnished written sequence listing does not go beyond the disclosure in the international application as filed has been furnished.
- ☐ The statement that the information recorded in computer readable form is identical to the written sequence listing has been furnished.

4. The amendments have resulted in the cancellation of:

- ☐ the description, pages:
- ☐ the claims, Nos.:

☐ the drawings, sheets:

5. ☐ This report has been established as if (some of) the amendments had not been made, since they have been considered to go beyond the disclosure as filed (Rule 70.2(c)):

   *(Any replacement sheet containing such amendments must be referred to under item 1 and annexed to this report.)*

6. Additional observations, if necessary:

## V. Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement

1. Statement

| | | | |
|---|---|---|---|
| Novelty (N) | Yes: | Claims | 5,7,10-16,19,21,22,26-30,32,35,37,39,41-43,45,46,53,54,56-66,69, 71,74-78,80,84,87,90,93-100,103-105 |
| | No: | Claims | 1-4,6,8,9,17,18,20,23-25,31,33,34,36,38,40,44,47-52,55,67,68,70,72,73,79,81-83,85,86,88,89,91-93,101,102 |
| Inventive step (IS) | Yes: | Claims | 5,7,19,21,22,26-30,53,61,62,66,69,71,74-78 |
| | No: | Claims | 1-4,6,8-18,20,23-25,31-52,54-60,63-65,67,68,70,72,73,79-105 |
| Industrial applicability (IA) | Yes: | Claims | 1-105 |
| | No: | Claims | |

2. Citations and explanations
   **see separate sheet**

## VII. Certain defects in the international application

The following defects in the form or contents of the international application have been noted:
**see separate sheet**

**To Section V**

1. Reference is made to the following documents:

   D1: JP-A-06 194733
   D2: JP-A-07 295064

Note: D* = US-A-5 937 213 is a family member of D1 and D2. It was published too late to be relevant. However, for language reasons, the examiner will cite some passages of D* after checking that they actually have their counterparts in D1 or D2.

   D3: EP-A- 725 292

2. Claim 1 lacks novelty in view of D1.

   D1 is directed to a camera which can photograph a scale, see Figs. 4 and 5 of either D1 or D*, i.e. to make an imprint of a scale graduation 15,19 with a scale unit 16,20 together with a picture of a subject recorded on photographic film. The subject distance D and the focal length f of the camera lens are determined using a rangefinder device 4 and a focal length detection device 5, then the photographic magnification X is calculated using Eq. (1): $X = f / D$. This value is used for generating on the film a graduation indicative of the scale of the subject. Hence D1 discloses all the steps of present claim 1.

3. The following dependent claims lack novelty:

   Claim 2: the scale of D1 is derived from the magnification, see Eq. (1).

   Claim 3: the scale of D1 is formed onto an imprinting region 13 located at the bottom portion of the photographic frame 12, see Fig. 3.

   Claim 4: according to D1 and D*, col. 5, l. 40 seq., the length of the reference scale is changed if the photographic magnification is changed. This implies that the computed value of the magnification of the image must be stored in between.

Claim 6: according to D1 and D*, col. 5, ll. 18-22, "the reference scale [is] imprinted [...] after exposing the photographic frame". This implies that the scale must be stored for a certain amount of time.

Claim 8: according to D*, col. 4, ll. 61-64, there is provided a control circuit which controls the imprinting of the reference scale based on the execution of a program. This is further exemplified in the Figs. 6 and 7 of D1 or D* related to electronic storage of magnification data.

Claim 9: the above mentioned data are stored in digital format, see D*, col. 6, l. 49 seq.: "the data [...] is stored beforehand in a CPU".

Claim 17: in D1 or D* (col. 6, ll. 42-43), the magnification is calculated by a calculation unit 100 which performs electronic computing.

Claim 18: according to Fig. 3 of D1 or D* (col. 5, ll. 18-24), the imprinting region 13 is located at the bottom portion of the photographic frame 12; however, it "can also can also be located at other portions".

Claim 20: the wording of this claim ("adjacent at least one edge") is rather broad. The imprinting region 13 of D1 may also be defined as such.

Claim 23: this is another example of broad wording ("adjacent the image") encompassing the embodiments of D1.

Claim 24: in D1, Figs. 4 and 5, the scale is formed by a plurality of spaced apart graduations.

Claim 25: these graduations are described and illustrated as being equi-spaced apart.

Claim 31: the measuring scale 16,20 of Figs. 4 and 5 of D1 corresponds to the metric measuring system.

Claim 33: in D1, a photographic film 11 is placed in the image plane.

Claim 34: this film constitutes a photosensitive medium.

Claim 36: in D1, Fig. 2 and D*, col. 6, ll. 16-17, a LED array 9a and a projecting optical system 91 are provided.

Claim 38: this system constitutes an electronic forming means.

Claim 40: according to Fig. 2 of D1 or D* (see also Fig. 6 and col. 5, l. 53 seq.), a LED drive circuit 9 converts the scale into electronic signals for driving the LED array 9a.

Claim 44: D1 is directed to a photographic camera, hence the image forming process is a photographic one.

4. The following apparatus claims lack novelty:

Claim 47: this independent apparatus claim corresponds to method claim 1.

Claims 48-52: these dependent claims merely contain features corresponding to claims 2-4, 6 mentioned in point 3 above. Furthermore, the photographic film of D1 clearly constitutes an image storing means.

Claim 55: D1 or D* (col. 4, l. 52) discloses a focal length detection device 5.

Claim 67: in D1 or D*, the control circuit 6 (col. 4, l. 59) and the photographic magnification calculation unit 100 (col. 6, l. 43) use the stored value of the focal length of the lens.

Claims 68, 70, 72, 73, 79; 81 and 85; 82 and 83; 86, 88: they substantially correspond to method claims 18, 20, 24, 25, 31, 33, 34, 36, 38, respectively.

Claim 89: Fig. 6 of D1 or D* illustrates the operation of the claimed printing means.

Claims 91 and 92; 93: see claims 8 and 9; 44, respectively.

5. Independent device claim 101 and dependent claim 102 lack novelty since they are directed to a photographic camera comprising a known apparatus, see point 4. D1 or D* is directed to a camera, not only to an apparatus.

6. Dependent method claims 10-16 lack an inventive step.

D2 is an application directed to a camera capable of imprinting a scale which camera is highly similar to that of D1 by the same applicant. For instance, Figs. 2, 3-5 of D2 are identical to Figs. 10, 4-6 of D1, respectively. D* is based on both D1 and D2. The passages cited hereafter come from D2 or from a corresponding portion of D*.

Claim 10 concerns magnification of an image computed as a function of:
V: distance of the image plane from the optical centre of the image-forming lens,
F: focal length of the lens (see also description, p. 15).

The formula mentioned in Fig. 6 of D2 (Fig. 19 of D*) is: $\text{Beta} = \frac{f}{D - f}$

where Beta: magnification;
f: focal length picture taking lens;
D: object distance (distance of object plane from optical centre of lens).

If D is much larger than f, the magnification is approximately equal to f / D as in Eq. (1) of D1.
It is well known, in the field of geometrical optics, to compute magnification as a function of the focal length and either of the object distance or the image distance, using the lens maker's formulas. An example of this is given in D3 which is directed to an image magnification control device, see the "Theory of Constant Image Magnification" on p. 8 seq.. Hence the fact of using the image distance (as in claim 10) instead of the object distance (as in D1 or D2) is not inventive.

Claims 11 and 12 merely specify that the distance V and the focal length f must be determined, which is self-obvious.

The formula recited in claim 13 can unambiguously derived from the equation giving Beta and/or the lens maker's formulas. The formula recited in claim 14 gives the same result with a mere change of sign.

In D1, the values of D and f are determined using a rangefinder device 4 (see D*, col. 4, l. 44) and a focal length detection device 5 comprising an encoder (col. 4, ll. 52-53). Converting methods "known and used in the art" are employed (col. 4, l. 58). Hence electronic computing and mechanical determination methods are employed in D1, and the fact that f can be determined by electronic computing (claim 15) and V can be determined mechanically (claim 16) belongs to obvious alternatives in the art.

7. The following dependent method claims are obvious or known in the art. Together with the claim or claims they depend upon, they do not define inventive subject-matter:

Claim 32: the use of the British Imperial System is an obvious alternative to the use of the metric measuring system.

Claim 35: a charge coupled device constitutes an obvious alternative to a photosensitive medium (claim 34). D1 and D2 are preferably but not exclusively directed to classical photographic cameras. D3, p. 3, ll. 31-32, insists on the applicability to all types of cameras including electronic cameras.

Claim 37: the use of a masking means is an alternative or a complement to the use of a light projecting means (claim 36) known from D1. In addition, the light output of the LEDs of D1 must be masked somehow in order not to illuminate unwanted portions of the photographic film.

Claim 39: according to D1 or D* (see col. 5, l. 53 seq.), the measuring scale is not only formed by an electronic forming means (claim 38) since the disclosed device also comprises several mechanical parts.

Claims 41-43: compare with claim 35: in an electronic camera, the image is

converted to electronic signals (claim 41) which can only be analogue (claim 42) or digital (claim 43).

Claims 45-46: compare with claims 35: the claimed processes constitute obvious alternatives to the photographic image forming process of claim 44.

8. Dependent claims 54, 56-60, and 63-65 lack an inventive step.

As said in point 6, it is necessary to know either V and F (present description) or D and f (D1 and D2) in order to compute magnification. In D1 and D2, D is evaluated using a rangefinder device. An obvious alternative would be to evaluate V instead of D using an appropriate sensing means. Such an alternative is disclosed in D3, see abstract, ll. 4-10: detection means are provided for detecting the distance between the actual rear focal point and the position of the image of infinitely distant objects. As can be seen from Figs. 6 and 7 of D3 and from the elementary laws of optics, this distance is equal to V - F using the present notation. Since in addition the device of D3 comprises focal length detection means (abstract, ll. 14-15), the determination of V according to present claim 54 is obvious. Claim 54 considered together with independent claim 47 therefore lacks an inventive step in view of either of D1 or D2 combined with D3.

The means for detecting or deriving V and F according to D3 are used for magnification computing, hence the features of claim 56 are obvious.

The first sensing means of claim 57 is obvious since it is equivalent to the focus position means and distance code plate 42 according to D3, p. 7, ll. 49-52 and Fig. 4. In D3, such means comprise electronic and mechanic parts, rendering the subject-matter of claims 58-60 obvious as well.

The second sensing means of claim 63 has its counterpart in D3, see the zoom position reading means which is a focal length detection means on p. 7, ll. 44-48 and Figs. 4-5. This detection means contains electronic parts (claim 64) and mechanical parts (claim 65).

9. Dependent apparatus claims 80, 84, 87, 94 and 95 respectively correspond to claims 32, 35, 37, 45 and 46 which are obvious.

10. The following dependent apparatus claims are obvious as well:

Claim 90: in the cited prior art, the various storing means are preferably electronic.

Claim 96: D3 discloses the use of the above mentioned control device in an electronic still camera (p. 3, l. 32), which is a synonym for digital camera.

Claims 97-100: these claims are directed to the incorporation of the apparatus of claim 47 (which is not novel) into several types of cameras which are known in the art. This incorporation is hinted to in D3, p. 3, l. 31: "applicability to all types of cameras".

Claims 103-105: these claims are directed to the known types of cameras mentioned in claims 98-100.

11. A few claims appear to recite the following features which are neither known nor rendered obvious by the documents cited above:

(a) Claims 5 and 7, and corresponding claim 53: the principle of storing the value of the magnification of the image or the measuring scale separately from the stored image departs from the teaching of D1 or D2 in which the magnification or the scale may be temporarily stored; however, after the image has been recorded on photographic film i.e. stored, these data are either imprinted on the film or discarded. D3 is not directed to the storage of a scale or a magnification factor.

(b) Claim 19 and corresponding claim 69: D1 and D2 disclose a scale whose position cannot be changed at will. D3 does not disclose any scale.

(c) Claim 21 and corresponding claim 71; claim 22: the cited documents are silent as to the concept of two scales adjacent a pair of adjacent edges of the image, or a

scale formed at its periphery.

(d) Claims 26-30 and corresponding claims 74-78: the cited documents are silent as to a scale comprising a circle.

(e) Claims 61, 62 and 66: in the cited documents, zoom lenses are used. It would make little sense to provide a zoom lens with means for inputting focal length since the latter continuously changes. Similarly, such a lens cannot be provided with a code indicating its focal length: only a code indicating a focal length range would make sense.

12. In view of the foregoing, independent method or apparatus claims which would include one or more of the features (a) through (e) would probably appear novel and inventive.

Applicant's attention, however, is drawn to the following:
- The set of claims should be linked by a common inventive concept providing unity of invention. To that regard, features (b), (c) and (d) might share such a common concept since a movable scale or two scales or a scale with a circle constitute alternative embodiments which are especially suitable for digital imaging since these images may be displayed in a number of ways which do not always respect the proportions of the objects. (They may become anamorphotic). By contrast, it is questionable that such a common concept exists between (a) on the one hand and (b)-(d) on the other hand, and such a concept cannot be seen at all between (e) and any of (a)-(d).
- For conciseness reasons, the number of independent claims of the same category must be kept to a minimum.

**To Section VII**

1. Independent device claims should be drafted in the two-part form using the features of D1 as to the preamble.

2. D1, D2 and D3 should be acknowledged in the description. The passages of the description corresponding to the newly filed claims should be reviewed for internal consistency.

PATENT COOPERATION TREATY

# PCT

## INTERNATIONAL SEARCH REPORT

(PCT Article 18 and Rules 43 and 44)

| Applicant's or agent's file reference | **FOR FURTHER ACTION** see Notification of Transmittal of International Search Report (Form PCT/ISA/220) as well as, where applicable, item 5 below. | |
|---|---|---|
| PE1115 | | |
| International application No. | International filing date *(day/month/year)* | (Earliest) Priority Date *(day/month/year)* |
| PCT/IE 00/ 00037 | 03/04/2000 | 01/04/1999 |
| Applicant | | |
| MONTAUT, Brian, Emile | | |

This International Search Report has been prepared by this International Searching Authority and is transmitted to the applicant according to Article 18. A copy is being transmitted to the International Bureau.

This International Search Report consists of a total of 3 sheets.

[X] It is also accompanied by a copy of each prior art document cited in this report.

1. **Basis of the report**

   a. With regard to the **language,** the international search was carried out on the basis of the international application in the language in which it was filed, unless otherwise indicated under this item.

   [ ] the international search was carried out on the basis of a translation of the international application furnished to this Authority (Rule 23.1(b)).

   b. With regard to any **nucleotide and/or amino acid sequence** disclosed in the international application, the international search was carried out on the basis of the sequence listing :

   [ ] contained in the international application in written form.

   [ ] filed together with the international application in computer readable form.

   [ ] furnished subsequently to this Authority in written form.

   [ ] furnished subsequently to this Authority in computer readble form.

   [ ] the statement that the subsequently furnished written sequence listing does not go beyond the disclosure in the international application as filed has been furnished.

   [ ] the statement that the information recorded in computer readable form is identical to the written sequence listing has been furnished

2. [ ] **Certain claims were found unsearchable** (See Box I).

3. [ ] **Unity of invention is lacking** (see Box II).

4. With regard to the **title,**

   [X] the text is approved as submitted by the applicant.

   [ ] the text has been established by this Authority to read as follows:

5. With regard to the **abstract,**

   [X] the text is approved as submitted by the applicant.

   [ ] the text has been established, according to Rule 38.2(b), by this Authority as it appears in Box III. The applicant may, within one month from the date of mailing of this international search report, submit comments to this Authority.

6. The figure of the **drawings** to be published with the abstract is Figure No. 1

   [ ] as suggested by the applicant.

   [ ] because the applicant failed to suggest a figure.

   [X] because this figure better characterizes the invention.

   [ ] None of the figures.

# INTERNATIONAL SEARCH REPORT

International Application No
[redacted]E 00/00037

**A. CLASSIFICATION OF SUBJECT MATTER**
IPC 7 G01B11/00 G01B11/02 G03B17/24

According to International Patent Classification (IPC) or to both national classification and IPC

**B. FIELDS SEARCHED**

Minimum documentation searched (classification system followed by classification symbols)
IPC 7 G01B G03B

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

**C. DOCUMENTS CONSIDERED TO BE RELEVANT**

| Category ° | Citation of document, with indication, where appropriate, of the relevant passages | Relevant to claim No. |
|---|---|---|
| P,X | US 5 937 213 A (MIYAMOTO HIDENORI ET AL)<br>10 August 1999 (1999-08-10)<br><br>abstract; figures 1A-5 | 1-4,24,<br>25,<br>47-50,<br>101-105 |
| P,Y | | 10-15,<br>56,57 |
| X | & JP 06 194733 A (NIKON CORP)<br>15 July 1994 (1994-07-15) | 1-4,24,<br>25,<br>47-50,<br>101-105 |
| Y | | 10-15,<br>56,57 |
| X | & JP 07 295064 A (NIKON CORP)<br>10 November 1995 (1995-11-10) | 1-4,24,<br>25,<br>47-50,<br>101-105 |
| Y | | 10-15,<br>56,57 |

-/--

[X] Further documents are listed in the continuation of box C.

[X] Patent family members are listed in annex.

° Special categories of cited documents :

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier document but published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.

"&" document member of the same patent family

| Date of the actual completion of the international search | Date of mailing of the international search report |
|---|---|
| 2 June 2000 | 13/06/2000 |

| Name and mailing address of the ISA | Authorized officer |
|---|---|
| European Patent Office, P.B. 5818 Patentlaan 2<br>NL – 2280 HV Rijswijk<br>Tel. (+31–70) 340–2040, Tx. 31 651 epo nl,<br>Fax: (+31–70) 340–3016 | Vorropoulos, G |

Form PCT/ISA/210 (second sheet) (July 1992)

# INTERNATIONAL SEARCH REPORT

International Application No
P[redacted]E 00/00037

C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT

| Category ° | Citation of document, with indication,where appropriate, of the relevant passages | Relevant to claim No. |
|---|---|---|
| Y | EP 0 725 292 A (ASAHI OPTICAL CO LTD)<br>7 August 1996 (1996-08-07)<br>abstract<br>page 8 -page 11; figures 6,7 | 10-15,<br>56,57 |

Form PCT/ISA/210 (continuation of second sheet) (July 1992)

# INTERNATIONAL SEARCH REPORT

Information on patent family members

International Application No
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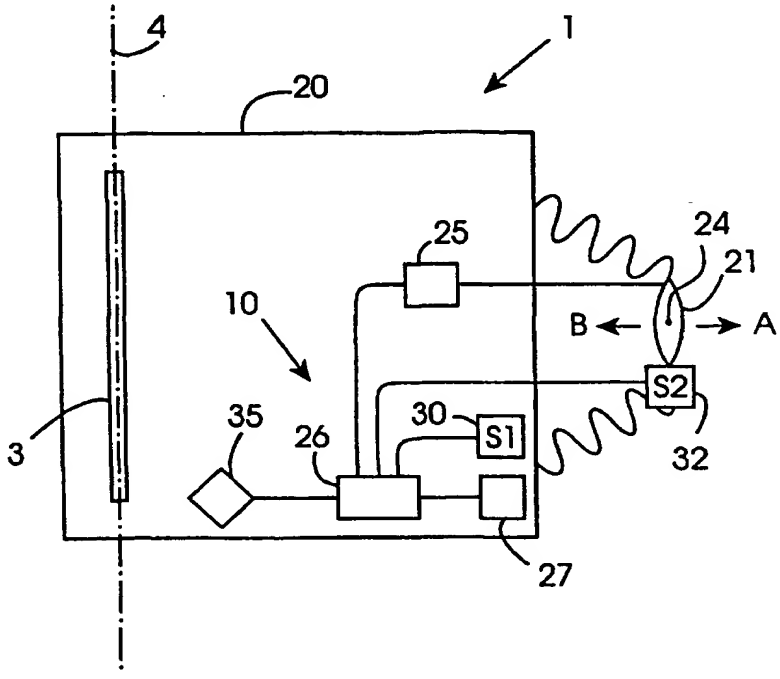
(54) Title: A METHOD AND APPARATUS FOR FACILITATING A DETERMINATION OF A LINEAR DIMENSION OF AN OBJECT FROM AN IMAGE OF THE OBJECT

(57) Abstract

A camera (1) comprises a microprocessor (26) which controls a light projector (35) for projecting a measuring scale (12) having graduations (15) onto two peripheral edges (17 and 18) of a film (3) in an image plane (4). The microprocessor (26) determines the magnification (positive or negative) of an image (2) formed on the film (3) relative to the object from which the image (2) is formed, and the spacing between the graduations (15) corresponds to the number of metric units represented by the spacing between the graduations (15) and the magnification of the image (2) so that when a print is made on photographic paper the linear dimensions of the image in the plane of the photographic paper can readily be read directly from the measuring scales which are formed on the photograph which correspond to the measuring scales (12). The dimensions read from the measuring scale (12) are the actual dimensions of the object.



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"A method and apparatus for facilitating a determination of a linear dimension of an object from an image of the object"

The present invention relates to a method and apparatus for facilitating a determination of a linear dimension of an object from an image of the object, and in particular, though not limited to a linear dimension of an object from an image of the object formed by an image forming process, such as a photographic or telephotographic process.

In many instances it is desirable to be able to determine one or more dimensions of an object by measuring an image of the object formed by a photographic or telephotographic process or other imaging process, for example, it is desirable that by measuring an image in a photograph of an object one should be able to determine the dimensions of the object.

There is therefore a need for a method and apparatus for facilitating a determination of a linear dimension of an object from an image of the object formed by a photographic, telephotographic or other imaging process.

The present invention is directed towards providing such a method and apparatus.

In this specification any and all references to magnification are intended to include reference to positive and negative magnification, in other words enlargement in the size of an object in image form and reduction in the size of an object in image form.

According to the invention there is provided a method for facilitating a determination of a linear dimension of an objection from image of the object formed by an image forming process, wherein the method comprises the step of computing the magnification of the image formed in an image plane of the image forming process relative to the object for facilitating the derivation of a measuring scale for subsequent reproduction along with a reproduction of the image, the magnification of the reproduced measuring scale corresponding to the magnification of the reproduced image.

In one embodiment of the invention the measuring scale is derived from the computed value of the magnification of the image.

In another embodiment of the invention the measuring scale derived from the computed value of magnification of the image is formed in the image plane along with the image.

In a further embodiment of the invention the computed value of the magnification of the image is stored. Preferably, the image is stored, and the stored computed value of the magnification of the image is stored separately from the stored image but correlated therewith.

In another embodiment of the invention the measuring scale is stored. Preferably, the measuring scale is stored separately from the stored image but correlated therewith.

Advantageously, the stored computed values of the magnification of the image and the measuring scale are stored electronically. Ideally, the stored computed values of the magnification of the image and the measuring scale are stored in digital format.

In one embodiment of the invention the magnification of the image is computed as a function of the distance of the image plane from the optical centre of a lens which forms the image of the object, and the focal length of the lens.

In another embodiment of the invention the method further comprises the step of determining the distance of the image plane from an optical centre of the lens which forms the image of the object.

In a still further embodiment of the invention the method further comprises the step of determining the focal length of the lens.

In one embodiment of the invention the magnification of the image is computed under the R.P. Convention by dividing the distance of the image plane from the optical centre of the lens by the focal length of the lens and subtracting the value one from the quotient of the division.

Alternatively, the magnification of the image is computed under the N.C. Convention by dividing the distance of the image plane from the optical centre of the lens by the focal length of the lens and subtracting the quotient of the division from the value one.

In one embodiment of the invention the distance of the image plane from the optical centre of the lens, and the focal length of the lens are determined by electronic computing. Alternatively, the distance of the image plane from the optical centre of the lens and the focal length of the lens are determined mechanically.

Preferably, the computation of the magnification of the image relative to the object is carried out by electronic computing.

In one embodiment of the invention the measuring scale is adapted to be formed in the image plane in a desired location relative to the image of the object.

In another embodiment of the invention the measuring scale is adapted to be moveable in the image plane relative to the image.

In a further embodiment of the invention the measuring scale is formed adjacent at least one edge of an area of the image plane within which the image is formed. Advantageously, a pair of measuring scales are formed adjacent a pair of adjacent edges of the area of the image plane within which the image is formed.

In a further embodiment of the invention the measuring scale is formed around the periphery of the area of the image plane within which the image is formed.

In a still further embodiment of the invention the measuring scale is formed adjacent the image.

In one embodiment of the invention the measuring scale is formed by a plurality of spaced apart graduations. Preferably, the graduations of the measuring scale are equi-spaced apart.

Alternatively, the measuring scale is provided by a circle, the diameter of which corresponds to one or more measuring units. Preferably, the type and number of measuring units to which the diameter of the circle corresponds are displayed along with the circle. Advantageously, the type and number of measuring units to which the diameter of the circle corresponds are displayed within the circle. Preferably, the circle is bisected by a line corresponding to a diameter of the circle. Advantageously, the diameter line extends horizontally.

In one embodiment of the invention the measuring scale corresponds to the metric measuring system. Alternatively, the measuring scale corresponds to the British Imperial System.

In one embodiment of the invention the image and the measuring scale is formed on a receiving means in the image plane. Preferably, the receiving means comprises a photosensitive medium.

In another embodiment of the invention the receiving means comprises a charge coupled device.

In another embodiment of the invention the measuring scale is formed by a light projecting means.

In a further embodiment of the invention the measuring scale is formed by a light masking means.

In a further embodiment of the invention the measuring scale is formed by an electronic forming means. Alternatively, the measuring scale is formed by a mechanical forming means.

In a further embodiment of the invention the measuring scale is converted to electronic signals, and preferably, in this embodiment of the invention the image is converted to electronic signals. Preferably, the electronic signals are analogue signals, and advantageously, the electronic signals are digital signals.

In one embodiment of the invention the image forming process is a photographic image forming process.

In another embodiment of the invention the image forming process is a telephotographic image forming process.

In a still further embodiment of the invention the image forming process is a video forming process.

Additionally, the invention provides apparatus for facilitating a determination of a linear dimension of an object from an image of the object formed by an image forming process wherein the apparatus comprises a computing means for computing the magnification of the image formed in an image plane of the image forming process relative to the object for facilitating the derivation of a measuring scale for subsequent reproduction along with a reproduction of the image, the magnification of the measuring scale corresponding to the magnification of the reproduced image.

In one embodiment of the invention a means is provided for deriving the measuring scale from the computed value of the magnification of the image.

In another embodiment of the invention a means for forming the measuring scale along with the image is provided.

In one embodiment of the invention a magnification storing means is provided for storing the computed value of the magnification of the image.

In another embodiment of the invention a measuring scale storing means is provided for storing the measuring scale.

In a further embodiment of the invention an image storing means is provided for storing the image.

Preferably, the magnification storing means and the measuring scale storing means are separate from the image storing means but correlated with the image storing means.

In one embodiment of the invention a means for determining the distance of the image plane from the optical centre of a lens which forms the image of the object is provided. Preferably, a means for determining the focal length of the lens is provided.

In one embodiment of the invention the computing means computes the magnification of the image from signals received from the means for determining the distance of the image plane from the optical centre of the lens and from signals received from the means for determining the focal length of the lens.

Preferably, the means for determining the distance of the image plane from the optical centre of the lens comprises a first sensing means for sensing the position of the lens relative to the image plane. Advantageously, the first sensing means is an electronic sensing means. Alternatively, the first sensing means is a mechanical sensing means.

In another embodiment of the invention the first sensing means comprises a combination of an electronic and a mechanical sensing means.

In one embodiment of the invention the means for determining the focal length of the lens comprises an input means for facilitating inputting of the focal length of the lens. Preferably, the input means comprises a manual inputting means.

In another embodiment of the invention the means for determining the focal length of the lens comprises a second sensing means for sensing the focal length of the lens. Preferably, the second sensing means is an electronic sensing means. Alternatively, the second sensing means is a mechanical sensing means.

In another embodiment of the invention the second sensing means comprises a reading means for reading a code on the lens indicating the focal length of the lens.

In another embodiment of the invention a focal length storing means is provided for storing the focal length of the lens.

In a further embodiment of the invention the means for forming the measuring scale is adapted for forming the measuring scale in the image plane at a desired location relative to the image.

In one embodiment of the invention the means for forming the measuring scale is adapted for facilitating movement of the measuring scale in the image plane relative to the image.

In another embodiment of the invention the means for forming the measuring scale forms the measuring scale adjacent one edge of an area of the image plane within which the image is formed.

In a further embodiment of the invention the means for forming the measuring scale forms the measuring scale adjacent two adjacent edges of the area of the image plane within which the image is formed.

In one embodiment of the invention the means for forming the measuring scale forms the measuring scale as a plurality of spaced apart graduations. Preferably, the graduations of the measuring scale are equi-spaced apart.

Alternatively, the means for forming the measuring scale forms the measuring scale in the form of a circle, the diameter of which corresponds to one or more measuring units. Preferably, the means for forming the measuring scale displays the type and number of measuring units to which the diameter of the circle correspond.

Advantageously, the type and number of measuring units to which the diameter of the circle corresponds is displayed within the circle. Advantageously, the means for forming the measuring scale forms a line corresponding to a diameter through the circle. Preferably, the line corresponding to the diameter of the circle extends horizontally across the circle.

In one embodiment of the invention the measuring scale corresponds to the metric measuring system. Advantageously, the measuring scale corresponds to the British Imperial Measuring System.

In one embodiment of the invention a receiving means is located in the image plane for receiving the image. Preferably, the receiving means comprises a photosensitive medium. Additionally or alternatively, the receiving means comprises a charge coupled device.

In one embodiment of the invention the receiving means comprises a light sensitive photographic medium.

In another embodiment of the invention the means for forming the measuring scale is adapted for forming the measuring scale on the receiving means.

In a further embodiment of the invention the means for forming the measuring scale comprises a light projecting means for projecting light onto the receiving means for

forming the measuring scale thereon. Additionally or alternatively, the means for forming the measuring scale comprises a light masking means.

In another embodiment of the invention the means for forming the measuring scale comprises an electronic forming means for electronically forming the measuring scale.

In a still further embodiment of the invention the means for forming the measuring scale comprises a printing means for printing the measuring scale on the receiving means.

Preferably, the magnification storing means, the image storing means and the measuring scale storing means are provided by electronic storing means. Advantageously, the magnification value of the image is stored in a digital format in the magnification storing means. Preferably, the measuring scale is stored in a digital format in the measuring scale storing means.

In one embodiment of the invention the apparatus is adapted for use in a photographic camera.

In another embodiment of the invention the apparatus is adapted for use is a telephotographic camera.

In a further embodiment of the invention the apparatus is adapted for use in a video camera.

In a still further embodiment of the invention the apparatus is adapted for use in a digital camera.

In a still further embodiment of the invention the apparatus is adapted for incorporation into a photographic camera.

In a still further embodiment of the invention the apparatus is adapted for incorporation into a telephotographic camera.

In another embodiment of the invention the apparatus is adapted for incorporation into a video camera.

In a further embodiment of the invention the apparatus is adapted for incorporation into a digital camera.

Further the invention provides a camera comprising the apparatus according to the invention.

In one embodiment of the invention the camera is a photographic camera.

In another embodiment of the invention the camera is a telephotographic camera.

In a further embodiment of the invention the camera is a video camera.

In a still further embodiment of the invention the camera is a digital camera.

The advantages of the invention are many. By virtue of the fact that a measuring scale is formed or provision is made for the subsequent formation of a measuring scale which can be subsequently reproduced with the image, and the fact that the measuring scale corresponds in magnification to the magnification of the image or any other subsequent reproduction of the image relative to the object, the linear dimensions of the image in the plane in which the image is formed can readily easily be determined by reference to the measuring scale, and the dimensions read from the measuring scale are the actual dimensions of the object. By forming the measuring scale to correspond with the magnification of the image as the image is reproduced to different scales, the scale will correspondingly vary to match the varying magnification of the image.

By projecting the measuring scale of a magnification corresponding to the magnification of the image onto the receiving means, such as a photosensitive medium, for example, a photosensitive photographic film, the film may be developed into a transparency or a photograph, and irrespective of the size to which the photograph is printed the magnification of the measuring scale will always correspond to the magnification of the image formed in the photograph. In other words, as the photograph is enlarged, thereby enlarging the image, the scale is proportionally enlarged, and vice versa. Furthermore, where the photographic film is developed onto a transparency, and the image on the transparency is projected onto a screen, as the projected image on the screen is enlarged or reduced, the measuring scale is proportionally enlarged or reduced. Accordingly, the actual linear dimensions of the object in the plane of the image can readily easily be read or ascertained from the measuring scale.

A further advantage of the invention is achieved when the image is stored electronically, as for example in the case of a telephotographic camera, such as a digital camera, video camera or the like, and when the magnification or measuring scale are similarly stored, since once the stored image of the object and its magnification or the measuring scale are correlated, as the image is reproduced on a larger or smaller scale, the magnification, and in turn the measuring scale will be automatically changed to correspond with the magnification of the image, and thus, by displaying the measuring scale along with the telephotographic image of the object the linear dimensions of the object in the plane of the image can readily easily be read from the measuring scale, and the dimensions read from the measuring scale are the actual dimensions of the object. The method and apparatus according to the invention are particularly advantageous where one wishes to determine the linear dimensions of a microscopic particle or organism an image of which can be recorded by an image forming process.

The invention will be more clearly understood from the following description of some preferred embodiments thereof which are given by way of example only with reference to the accompanying drawings, in which:

Fig. 1 is a schematic representation of a camera according to the invention incorporating apparatus also according to the invention for forming a measuring scale on a photosensitive medium,

Fig. 2 is a block representation of the apparatus for forming the measuring scale of Fig. 1,

Fig. 3 is a plan view of a photographic film of the camera of Fig. 1,

Fig. 4 is a plan view of a photograph reproduced from the photographic film of Fig. 3,

Fig. 5 is a plan view of an alternative photograph reproduced from a film of the camera of Fig. 1,

Fig. 6 are alternative representations of scales which may be used in connection with the photograph of Fig. 5, and indeed in connection with the photograph of Fig. 4, and

Fig. 7 is a view similar to Fig. 1 of a digital camera also according to the invention.

Referring to the drawings and initially to Figs. 1 to 4 there is illustrated a photographic camera according to the invention indicated generally by the reference numeral 1. The camera 1 is of the type which forms an image 2 of an object (not shown) on a receiving means, namely, a photosensitive photographic film 3 in an image forming plane 4 in the camera 1. The film 3 is subsequently removed from the camera 1 and developed to form the image 2. A photograph 7 may be reproduced from the film 3 and/or a transparency for facilitating projection of an image of the transparency onto a screen. In Fig. 3 the photograph 7 is illustrated and as can be seen is an enlarged version of the film 3. The print of the image which is indicated by the reference numeral 8 in the photograph 7 is correspondingly magnified, in other words, enlarged relative to the image 2 on the film 3.

The camera 1 incorporates apparatus also according to the invention indicated generally by the reference numeral 10 for forming a measuring scale 12 along with the image 2 on the film 3 so that on printing the image of the film 3 onto the photograph 7 a print of a measuring scale 14 which corresponds to the measuring scale 12 on the film 3 is reproduced. The measuring scales 12 and 14 are metric scales and the magnification of the measuring scales 12 and 14 correspond to the magnification of the images 2 and 8, respectively, relative to the object (not shown), so that the linear dimensions of the images 2 and 8 in the plane of the film 3 and photograph 7, respectively, can readily easily be measured from the measuring scales 12 and 14, respectively, and these linear dimensions of the image are the actual dimensions of the object (not shown).

In this embodiment of the invention the measuring scale 12 formed on the film 3 comprises a plurality of graduations 15 which are equi-spaced along two peripheral edges 17 and 18 of the film 3. The graduations 15 are equi-spaced and correspond to units or a predetermined number of units of the metric system, depending on the magnification of the image 2, whether the magnification is positive or negative or zero. However, the spacing between the graduations 15 correspond to the spacing between the appropriate units or number of units on a metric scale magnified to the same level of magnification of the image 2 relative to the object. For example, if the image 2 has been positively magnified, in other words enlarged relative to the object by a factor of 5 and the spacing between adjacent graduations 15 of the measuring scale 12 is to corresponded to 1mm of the object, then the actual spacing between each graduation of the measuring scale 12 on the film 3 would be 5mm. Intermediate graduations could be included between the graduations 15. Similarly, if the image 2 had been negatively magnified, in other words reduced relative to the object and, for example, was reduced by a factor of 5, and the spacing between adjacent graduations 15 of the measuring scale 12 is to correspond to 1cm of the object, then the actual spacing between the graduations 15 on the measuring scale 12 would be $^1/_5$cm. Accordingly, as photographs 7 are produced from the film 3, as the image 2 in the photograph 7 is enlarged or reduced, the measuring scale 14 on the photograph 7 is correspondingly enlarged or reduced. Thus, irrespective of the state of

enlargement or reduction of the photograph relative to the film, and in turn the positive or negative magnification of the image relative to the object, by reading the linear dimensions of the image 8 in the plane of the photograph 7 the corresponding linear dimensions of the object are provided.

Turning now to the camera 1 and the apparatus 2, the camera 1 comprises a housing 20. A lens 21 which forms the image 2 of the object (not shown) in the image plane 4 on the film 3 is moveably mounted in the housing 20 for altering the distance between an optical centre 24 of the lens 21 and the image plane 4. In this embodiment of the invention the focal length of the lens 21 is fixed, although, the housing 20 is adapted for receiving lenses of different focal lengths and/or combinations of lenses with variable/adjustable focal lengths. A drive means, namely, a drive motor 25 is located within the housing 20 for driving the lens 21 in the directions of the arrows A and B for varying the distance between the optical centre 24 of the lens 21 and the image plane 4. A microprocessor 26 also located in the housing 20 controls the operation of the camera 1 and the drive motor 25 for focusing the image 2 of the object (not shown) in the image plane 4. An automatic focusing device 27 which will be well known to those skilled in the art is also located in the housing 20 for detecting the location of the object. The microprocessor 26 in response to signals received from the auto-focusing device 27 operates the drive motor 25 for moving the lens 21 for in turn focusing the image 2 of the object (not shown) in the image plane 4.

In this embodiment of the invention the apparatus 10 shares the microprocessor 26 with the camera 1, although, it will be appreciated that the apparatus 10 may be provided with a separate microprocessor, which would communicate with the microprocessor controlling the camera 1. This would particularly be the case in the event of the apparatus 10 being retro-fitted to the camera 1.

A means for determining the distance between the optical centre 24 of the lens 21 and the image plane 4 comprises a first sensor 30 which senses the position of the lens 21, and in turn its optical centre 24 relative to the image plane 4. A means for determining the focal length of the lens 21 comprises a second sensor 32 which

senses the type of lens 21 fitted into the camera 1, and thus the focal length of the lens 21 can be determined by the microprocessor 26 from a look-up table stored in the microprocessor 26. The second sensor 32 is provided with a reading means for reading a code on the lens which identifies the lens type. The microprocessor 26 is programmed using suitable code for computing from the signals received from the first sensor 30 the distance between the optical centre 24 of the lens 21 and the image plane 4, and is also programmed using suitable code for computing the magnification of the image 2 of the object formed in the image plane 4 on the film 3 relative to the object.

In this embodiment of the invention the magnification of the image 2 relative to the object is derived in accordance with the R.P. Convention from the formula:

$$M = V/F - 1$$

where M = magnification,

V = distance of the optical centre 24 of the lens 21 from the image plane 4, and

F = focal length of the lens 21.

Alternatively, the magnification of the image 2 formed in the image plane 4 on the film 3 relative to the object (not shown) may be derived from the following formula using the N.C. Convention:

$$M = 1 - V/F$$

where V = distance of the optical centre 24 of the lens 21 from the image plane 4, and

F = focal length of the lens 21.

A means for deriving the measuring scale 12 to be projected onto the film 3 in the image plane 4 comprises suitable code in the microprocessor 26 which computes the measuring scale 12 from the computed value of the magnification of the image. A means for forming the measuring scale 12 on the film 3 comprises a light projecting means, namely, a light projector 35 which under the control of the microprocessor 26 projects short lines of light onto the film 3 in the image plane 4 for forming the graduations 15 of the measuring scale 12 adjacent the peripheral edges

17 and 18 of the film 3. The short lines of light are projected for forming the graduations 15 of the measuring scale 12 spaced apart the appropriate distance from each other corresponding to the number of metric units between the graduations 15 and the magnification of the image 2 relative to the object (not shown). Such light projectors as the light projector 35 will be well known to those skilled in the art, and are typically of the type used for printing a date or time onto a film in a camera.

Accordingly, when the film 3 is developed, and the image of the film is subsequently printed onto photographic paper or onto a transparency the image 2 is formed as a printed image 8 on the photograph 7, and the measuring scale 12 is printed as the measuring scale 14 on photograph 7. As discussed above as the image of the film 3 is enlarged or reduced, as the case may be in a printing process onto a photographic paper or onto a transparency the image 8 and the measuring scale 14 are correspondingly enlarged or reduced as the case may be.

Referring now to Figs. 5 and 6 there is illustrated a film 40 of an image 41 of an object (not shown) which has been formed in a camera (not shown) also according to the invention. The camera according to this embodiment of the invention is identical to the camera 1 with the exception that the light projector 35 instead of projecting a scale of graduations as in the case of the camera 1 of the Figs. 1 to 4, projects a measuring scale in the form of a diameter 42 of a circle 43. The diameter 42 of the circle 43 represents a number of units in the metric system corresponding to the magnification of the image 41 relative to the object (not shown). In this embodiment of the invention the length of the diameter 42 represents 10cm, and the number of units, namely, the numeral "10" is displayed within the circle 43 above the diameter 42 and the type of units, namely, "cms" is displayed beneath the diameter 42 within the circle 43. The type and number of units which is represented by the diameter 42 of the circle 43 is relayed by the microprocessor to the light projector 35 for projecting along with the circle 43 and diameter 42 onto the film 3 in the image plane 4. In this embodiment of the invention the circle 43 is located towards the lower right hand corner of the film 3, although, it will be readily appreciated that the

circle 43 may be located in any desired position on the film by appropriately directing the light projector 35 onto the film 3 in the image plane 4.

Referring now in particular to Fig. 5 alternative arrangements of measuring scales according to the invention provided by circles 43 as well as the type and number of units represented by the length of the diameter of the circles 43 are illustrated.

Referring now to Fig. 7 there is illustrated a camera, in this embodiment of the invention a telephotographic camera, namely, a digital camera also according to the invention and indicated generally by the reference numeral 50. The digital camera 50 incorporates apparatus also according to the invention indicated generally by the reference numeral 51 for deriving and storing a measuring scale of an image formed by the camera 50. Although a digital camera 50, the main components of the camera 50 are substantially similar to those of the camera 1, as are the main components of the apparatus 51 substantially similar to those of the apparatus 10, and similar components are identified by the same reference numerals. In this embodiment of the invention the camera 50 comprises a housing 20, a lens 21 located in the housing 20 and moveably mounted relative to the housing 20 for varying the distance between the optical centre 24 of the lens 21 and the image plane 4 of the camera 20. Instead of a film 3 a photosensitive medium, namely, a charge coupled device 52 is located in the image plane 4 for receiving the image. Light through the lens 21 before being focused on the charge coupled device 52 is split by defraction through a prism (not shown) or other suitable splitting means into the primary colours of red, green and blue, which are then directed onto the charge coupled device 52. Analogue signals of the image of the object formed on the charge coupled device 52 are relayed to an analogue-to-digital converter 54, and in turn the digital signals of the image from the analogue-to-digital converter 54 are read by the microprocessor 26 for encoding for forming a digital representation of the image. The digital image is in turn stored by the microprocessor 26 in a suitable image storing means, which typically is a memory card or disc 56.

The auto-focusing device 27 in conjunction with the microprocessor 26 and the drive motor 25 moves the lens 21 relative to the image plane 4 for focusing the image of

the object on the charge coupled device 52 in the image plane 4 as already described with reference to Fig. 1. The distance between the optical centre 24 of the lens 21 and the image plane 4 and the focal length of the lens 21 are determined by the microprocessor 26 from signals received from the first and second sensors 30 and 32, respectively, as already described with reference to the camera 1 and the apparatus 10 of Figs. 1 to 4. The microprocessor 26 similarly determines the magnification of the image formed in the image plane 4 on the charge coupled device 52 and in turn derives a measuring scale as already described.

The measuring scale is stored in a measuring scale storing means, which is also provided by the memory card or disc 56, and preferably is stored in a location on the memory card or disc 56 separate from the location at which the image is stored on the memory card or disc 56. If desired the magnification of the image may also be stored in a magnification storing means, which is also provided by the memory card or disc 56, and preferably, is stored in a location on the memory card or disc 56 separate from the stored image and the stored measuring scale.

Accordingly, when an image is being reproduced from the memory card or disc 56 the measuring scale can be separately retrieved from the memory card or disc 56 and moved to any desired location relative to the image, and indeed, the orientation of the measuring scale may also be varied relative to the image for facilitating direct measuring of the image by placing the measuring scale across the image between the points of the image, across which the linear distance is to be determined. The measuring scale and image will be stored so that as the image is enlarged on reproduction the measuring scale is correspondingly enlarged and reproduced. While it is not essential, the storing of the magnification value of the image would facilitate enlargement or reduction of the measuring scale to correspond with enlargement or reduction of the image.

While the components of the digital camera 50 for forming the digital image on the memory card or disc 56 have not been described in detail, digital cameras, and the formation of a digital image will be well known to those skilled in the art.

A further advantage of storing the image and the measuring scale and/or the magnification of the image separately from each other is that the image if desired could be displayed without the measuring scale. Furthermore, separate storage would also facilitate independent operation of the measuring scale, for example, movement of the measuring scale would be facilitated so that the measuring scale could be moved to any part of the image for determining the dimensions between any two points on the image, which in turn would give the actual distance of the two points on the object of which the image is formed. It is also envisaged that a menu of different types of measuring scale could be provided and one could select a specific type of measuring scale. Accordingly, by separately storing the image and the magnification of the image a selected measuring scale could then be prepared electronically from the value of magnification of the image. Thus, by separately storing the image and the measuring scale and/or the magnification the image and type of measuring scale and its position could be determined when a print is being made of the image, or when the image is being viewed. As discussed above the measuring scale could be moved relative to the image during viewing.

Additionally, in a digital or video camera the measuring scale could be selected and programmed to appear during specific frames only, and in cases where the magnification of the image remains constant throughout a sequence of frames, recalculation of the magnification and/or the measuring scale would be avoided.

While two methods for determining the magnification of the image have been described, it is also envisaged that the magnification may be computed by the microprocessor using the following formula:

$$M = V/U$$

where M = magnification,

V = distance from the optical centre 24 of the lens 21 from the image plane 4, and

U = distance of the object from the optical centre 24 of the lens 21.

In determining the magnification using this formula, the value of "U" would be determined by the microprocessor 26 of the apparatus 10 and 51 from signals received from the auto-focusing device 27.

While various types of measuring scales have been described, it will be readily apparent to those skilled in the art that any other suitable measuring scales may be provided. It will also of course be appreciated that the measuring scales may be formed in any other suitable location on the film, for example, it is envisaged that the measuring scales may be provided on X and Y axis which would bisect the film vertically and horizontally.

While the apparatus according to the invention has been described for use in a photographic camera and in a digital camera, it will be readily apparent to those skilled in the art that the apparatus according to the invention could be used in any other type of photographic or telephotographic camera, for example, in a video camera, a video camcorder, or in any other such image forming device, apparatus or process.

Claims

1. A method for facilitating a determination of a linear dimension of an objection from image (2,41,8) of the object formed by an image forming process (1,50), characterised in that the method comprises the step of computing the magnification of the image (2,41) formed in an image plane (4) of the image forming process (1,50) relative to the object for facilitating the derivation of a measuring scale (12,42,14) for subsequent reproduction along with a reproduction of the image (2,41,8), the magnification of the reproduced measuring scale (12,42,14) corresponding to the magnification of the reproduced image (2,41).

2. A method as claimed in Claim 1 characterised in that the measuring scale (12,42,14) is derived from the computed value of the magnification of the image (2,41).

3. A method as claimed in Claim 1 or 2 characterised in that the measuring scale (12,42) derived from the computed value of magnification of the image (2,41) is formed in the image plane (4) along with the image (2,41).

4. A method as claimed in any preceding claim characterised in that the computed value of the magnification of the image (2) is stored.

5. A method as claimed in Claim 4 characterised in that the image is stored, and the stored computed value of the magnification of the image (2) is stored separately from the stored image (2) but correlated therewith.

6. A method as claimed in any preceding claim characterised in that the measuring scale (12,42) is stored.

7. A method as claimed in Claim 6 characterised in that the measuring scale (12,42) is stored separately from the stored image (2) but correlated therewith.

8. A method as claimed in any of Claims 4 to 7 characterised in that the stored computed values of the magnification of the image (2) and the measuring scale (12,42) are stored electronically.

9. A method as claimed in Claim 8 characterised in that the stored computed values of the magnification of the image (2) and the measuring scale (12.42) are stored in digital format.

10. A method as claimed in any preceding claim characterised in that the magnification of the image (2) is computed as a function of the distance of the image plane (4) from the optical centre (24) of a lens (21) which forms the image (2) of the object, and the focal length of the lens (21).

11. A method as claimed in Claim 10 characterised in that the method further comprises the step of determining the distance of the image plane (4) from an optical centre (24) of the lens (21) which forms the image (2) of the object.

12. A method as claimed in Claim 10 or 11 characterised in that the method further comprises the step of determining the focal length of the lens (21).

13. A method as claimed in any of Claims 10 to 12 characterised in that the magnification of the image (2) is computed under the R.P. Convention by dividing the distance of the image plane (4) from the optical centre (24) of the lens (21) by the focal length of the lens (21) and subtracting the value one from the quotient of the division.

14. A method as claimed in any of Claims 10 to 12 characterised in that the magnification of the image (2) is computed under the N.C. Convention by dividing the distance of the image plane (4) from the optical centre (24) of the lens (21) by the focal length of the lens (21) and subtracting the quotient of the division from the value one.

15. A method as claimed in any of Claims 10 to 14 characterised in that the distance of the image plane (4) from the optical centre (24) of the lens (21), and the focal length of the lens (21) are determined by electronic computing (26).

16. A method as claimed in any of Claims 10 to 14 characterised in that the distance of the image plane (4) from the optical centre (24) of the lens (21) and the focal length of the lens (21) are determined mechanically.

17. A method as claimed in any preceding claim characterised in that the computation of the magnification of the image (2) relative to the object is carried out by electronic computing (26).

18. A method as claimed in any preceding claim characterised in that the measuring scale (12,42) is adapted to be formed in the image plane in a desired location relative to the image of the object.

19. A method as claimed in any preceding claim characterised in that the measuring scale (12,42) is adapted to be moveable in the image plane (4) relative to the image (2).

20. A method as claimed in any preceding claim characterised in that the measuring scale (12,42) is formed adjacent at least one edge (17,18) of an area of the image plane (4) within which the image (2) is formed.

21. A method as claimed in Claim 20 characterised in that a pair of measuring scales (12) are formed adjacent a pair of adjacent edges (17,18) of the area of the image plane (4) within which the image (2) is formed.

22. A method as claimed in Claim 20 or 21 characterised in that the measuring scale (12) is formed around the periphery of the area of the image plane (4) within which the image (2) is formed.

23. A method as claimed in any preceding claim characterised in that the measuring scale (12,42) is formed adjacent the image (2).

24. A method as claimed in any preceding claim characterised in that the measuring scale (12) is formed by a plurality of spaced apart graduations (15).

25. A method as claimed in Claim 24 characterised in that the graduations (15) of the measuring scale (12) are equi-spaced apart.

26. A method as claimed in any of Claims 1 to 23 characterised in that the measuring scale (42) is provided by a circle (43), the diameter (42) of which corresponds to one or more measuring units.

27. A method as claimed in Claim 26 characterised in that the type and number of measuring units to which the diameter (42) of the circle (43) corresponds are displayed along with the circle (43).

28. A method as claimed in Claim 27 characterised in that the type and number of measuring units to which the diameter (42) of the circle (43) corresponds are displayed within the circle (43).

29. A method as claimed in any of Claims 26 to 28 characterised in that the circle (43) is bisected by a line corresponding to a diameter (42) of the circle.

30. A method as claimed in Claim 29 characterised in that the diameter line (42) extends horizontally.

31. A method as claimed in any preceding claim characterised in that the measuring scale (12,42) corresponds to the metric measuring system.

32. A method as claimed in any of Claims 1 to 30 characterised in that the measuring scale (12,42) corresponds to the British Imperial System.

33. A method as claimed in any preceding claim characterised in that the image and the measuring scale (12,42) is formed on a receiving means (3,52) in the image plane (4).

34. A method as claimed in Claim 33 characterised in that the receiving means (3,52) comprises a photosensitive medium (3,52).

35. A method as claimed in Claim 33 or 34 characterised in that the receiving means (3,52) comprises a charge coupled device.

36. A method as claimed in any preceding claim characterised in that the measuring scale (12,42) is formed by a light projecting means (35).

37. A method as claimed in any preceding claim characterised in that the measuring scale (12,42) is formed by a light masking means.

38. A method as claimed in any preceding claim characterised in that the measuring scale (12,42) is formed by an electronic forming means (26).

39. A method as claimed in any of Claims 1 to 37 characterised in that the measuring scale (12,42) is formed by a mechanical forming means.

40. A method as claimed in any preceding claim characterised in that the measuring scale (12,42) is converted to electronic signals.

41. A method as claimed in any preceding claim characterised in that the image (2) is converted to electronic signals.

42. A method as claimed in Claim 40 or 41 characterised in that the electronic signals are analogue signals.

43. A method as claimed in Claim 40 or 41 characterised in that the electronic signals are digital signals.

44. A method as claimed in any preceding claim characterised in that the image forming process (1,50) is a photographic image forming process.

45. A method as claimed in any of Claims 1 to 43 characterised in that the image forming process (1,50) is a telephotographic image forming process.

46. A method as claimed in any of Claims 1 to 43 characterised in that the image forming process (1,50) is a video forming process.

47. Apparatus for facilitating a determination of a linear dimension of an object from an image (2,41,8) of the object formed by an image forming process characterised in that the apparatus (10,51) comprises a computing means (26) for computing the magnification of the image (2,41) formed in an image plane (4) of the image forming process relative to the object for facilitating the derivation of a measuring scale (12,42,14) for subsequent reproduction along with a reproduction of the image (2,41,8), the magnification of the measuring scale (12,42,14) corresponding to the magnification of the reproduced image (2,8).

48. Apparatus as claimed in Claim 47 characterised in that a means (26) is provided for deriving the measuring scale (12,42) from the computed value of the magnification of the image (2,41).

49. Apparatus as claimed in Claim 47 or 48 characterised in that a means (35) for forming the measuring scale along with the image is provided.

50. Apparatus as claimed in any of Claims 47 to 49 characterised in that a magnification storing means (56) is provided for storing the computed value of the magnification of the image (2,41).

51. Apparatus as claimed in any of Claims 47 to 50 characterised in that a measuring scale storing means (56) is provided for storing the measuring scale (12,42).

52. Apparatus as claimed in any of Claims 47 to 51 characterised in that an image storing means (56) is provided for storing the image (2,8).

53. Apparatus as claimed in any of Claims 50 to 52 characterised in that the magnification storing means and the measuring scale storing means are separate from the image storing means but correlated with the image storing means.

54. Apparatus as claimed in any of Claims 47 to 53 characterised in that a means (30) for determining the distance of the image plane (4) from the optical centre (24) of a lens (21) which forms the image of the object is provided.

55. Apparatus as claimed in any of Claims 47 to 54 characterised in that a means (32) for determining the focal length of the lens (21) is provided.

56. Apparatus as claimed in Claim 54 or 55 characterised in that the computing means (26) computes the magnification of the image (2,41) from signals received from the means (30) for determining the distance of the image plane (4) from the optical centre (24) of the lens (21) and from signals received from the means (32) for determining the focal length of the lens (21).

57. Apparatus as claimed in any of Claims 54 to 56 characterised in that the means for determining the distance of the image plane (4) from the optical centre of the lens comprises a first sensing means (30) for sensing the position of the lens relative to the image plane.

58. Apparatus as claimed in Claim 57 characterised in that the first sensing means (30) is an electronic sensing means.

59. Apparatus as claimed in Claim 57 characterised in that the first sensing means (30) is a mechanical sensing means.

60. Apparatus as claimed in Claim 57 characterised in that the first sensing means (30) comprises a combination of an electronic and a mechanical sensing means.

61. Apparatus as claimed in any of Claims 54 to 56 characterised in that the means (32) for determining the focal length of the lens comprises an input means for facilitating inputting of the focal length of the lens.

62. Apparatus as claimed in Claim 61 characterised in that the input means comprises a manual inputting means.

63. Apparatus as claimed in any of Claims 54 to 60 characterised in that the means for determining the focal length of the lens comprises a second sensing means (32) for sensing the focal length of the lens.

64. Apparatus as claimed in Claim 63 characterised in that the second sensing means (32) is an electronic sensing means.

65. Apparatus as claimed in Claim 63 characterised in that the second sensing means (32) is a mechanical sensing means.

66. Apparatus as claimed in any of Claims 63 to 65 characterised in that the second sensing means (32) comprises a reading means for reading a code on the lens indicating the focal length of the lens.

67. Apparatus as claimed in any of Claims 47 to 66 characterised in that a focal length storing means is provided for storing the focal length of the lens.

68. Apparatus as claimed in any of Claims 47 to 67 characterised in that the means (35) for forming the measuring scale (12,42) is adapted for forming the measuring scale in the image plane at a desired location relative to the image.

69. Apparatus as claimed in any of Claims 47 to 68 characterised in that the means (35) for forming the measuring scale (12,42) is adapted for facilitating movement of the measuring scale in the image plane relative to the image.

70. Apparatus as claimed in any of Claims 47 to 69 characterised in that the means (35) for forming the measuring scale (12,42) forms the measuring scale adjacent one edge of an area of the image plane within which the image is formed.

71. Apparatus as claimed in any of Claims 47 to 70 characterised in that the means (35) for forming the measuring scale (12,42) forms the measuring scale adjacent two adjacent edges of the area of the image plane within which the image is formed.

72. Apparatus as claimed in any of Claims 47 to 71 characterised in that the means (35) for forming the measuring scale (12,42) forms the measuring scale as a plurality of spaced apart graduations (15).

73. Apparatus as claimed in Claim 72 characterised in that the graduations (15) of the measuring scale are equi-spaced apart.

74. Apparatus as claimed in any of Claims 47 to 73 characterised in that the means (35) for forming the measuring scale (12,42) forms the measuring scale in the form of a circle (43), the diameter (42) of which corresponds to one or more measuring units.

75. Apparatus as claimed in Claim 74 characterised in that the means (35) for forming the measuring scale (42) displays the type and number of measuring units to which the diameter (42) of the circle (43) correspond.

76. Apparatus as claimed in Claim 75 characterised in that the type and number of measuring units to which the diameter of the circle corresponds is displayed within the circle (43).

77. Apparatus as claimed in any of Claims 74 to 76 characterised in that the means for forming the measuring scale forms a line corresponding to a diameter through the circle (43).

78. Apparatus as claimed in Claim 77 characterised in that the line corresponding to the diameter (42) of the circle extends horizontally across the circle (43).

79. Apparatus as claimed in any of Claims 47 to 78 characterised in that the measuring scale (12,42) corresponds to the metric measuring system.

80. Apparatus as claimed in any of Claims 47 to 78 characterised in that the measuring scale (12,42) corresponds to the British Imperial Measuring System.

81. Apparatus as claimed in any of Claims 47 to 80 characterised in that a receiving means (3,52) is located in the image plane (4) for receiving the image.

82. Apparatus as claimed in Claim 81 characterised in that the receiving means (3,52) comprises a photosensitive medium.

83. Apparatus as claimed in Claim 81 or 82 characterised in that the receiving means (3,52) comprises a light sensitive photographic medium.

84. Apparatus as claimed in any of Claims 81 to 83 characterised in that the receiving means (3,52) comprises a charge coupled device.

85. Apparatus as claimed in any of Claims 81 to 84 characterised in that the means (35) for forming the measuring scale (12,42) is adapted for forming the measuring scale on the receiving means (3,52).

86. Apparatus as claimed in any of Claims 81 to 85 characterised in that the means (35) for forming the measuring scale (12,42) comprises a light projecting means (35) for projecting light onto the receiving means (3) for forming the measuring scale thereon.

87. Apparatus as claimed in any of Claims 81 to 86 characterised in that the means (35) for forming the measuring scale (12,42) comprises a light masking means.

88. Apparatus as claimed in any of Claims 81 to 87 characterised in that the means (26) for forming the measuring scale comprises an electronic forming means for electronically forming the measuring scale.

89. Apparatus as claimed in any of Claims 81 to 88 characterised in that the means for forming the measuring scale comprises a printing means for printing the measuring scale on the receiving means.

90. Apparatus as claimed in any of Claims 47 to 89 characterised in that the magnification storing means, the image storing means and the measuring scale storing means are provided by electronic storing means.

91. Apparatus as claimed in any of Claims 47 to 90 characterised in that the magnification value of the image is stored in a digital format in the magnification storing means (56).

92. Apparatus as claimed in any of Claims 47 to 91 characterised in that the measuring scale is stored in a digital format in the measuring scale storing means (56).

93. Apparatus as claimed in any of Claims 47 to 92 characterised in that the apparatus (10,51) is adapted for use in a photographic camera.

94. Apparatus as claimed in any of Claims 47 to 92 characterised in that the apparatus (10,51) is adapted for use is a telephotographic camera.

95. Apparatus as claimed in any of Claims 47 to 92 characterised in that the apparatus (10,51) is adapted for use in a video camera.

96. Apparatus as claimed in any of Claims 47 to 92 characterised in that the apparatus (10,51) is adapted for use in a digital camera.

97. Apparatus as claimed in any of Claims 47 to 96 characterised in that the apparatus (10,51) is adapted for incorporation into a photographic camera.

98. Apparatus as claimed in any of Claims 47 to 96 characterised in that the apparatus (10,51) is adapted for incorporation into a telephotographic camera.

99. Apparatus as claimed in any of Claims 47 to 96 characterised in that the apparatus (10,51) is adapted for incorporation into a video camera.

100. Apparatus as claimed in any of Claims 47 to 96 characterised in that the apparatus (10,51) is adapted for incorporation into a digital camera.

101. A camera characterised in that the camera comprises the apparatus (10,51) as claimed in any of Claims 47 to 100.

102. A camera as claimed in Claim 101 characterised in that the camera is a photographic camera (1).

103. A camera as claimed in Claim 101 characterised in that the camera is a telephotographic camera (50).

104. A camera as claimed in Claim 101 characterised in that the camera is a video camera.

105. A camera as claimed in Claim 101 characterised in that the camera is a digital camera (50).

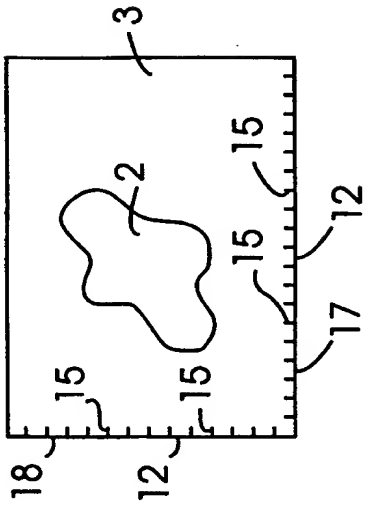


Fig. 3

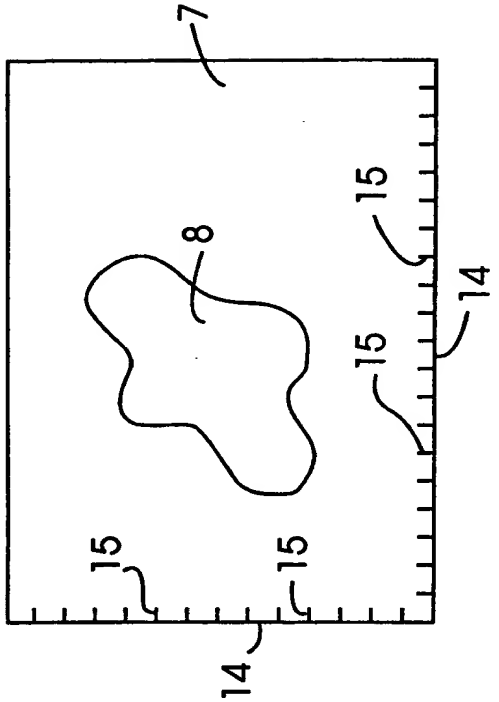


Fig. 4

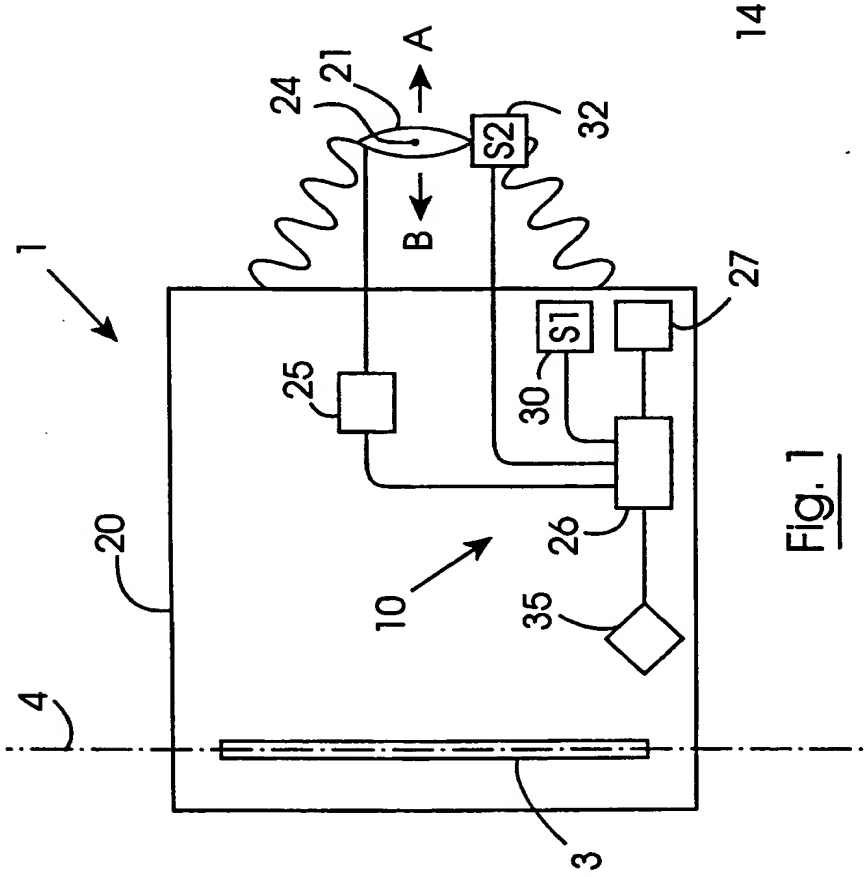


Fig. 1

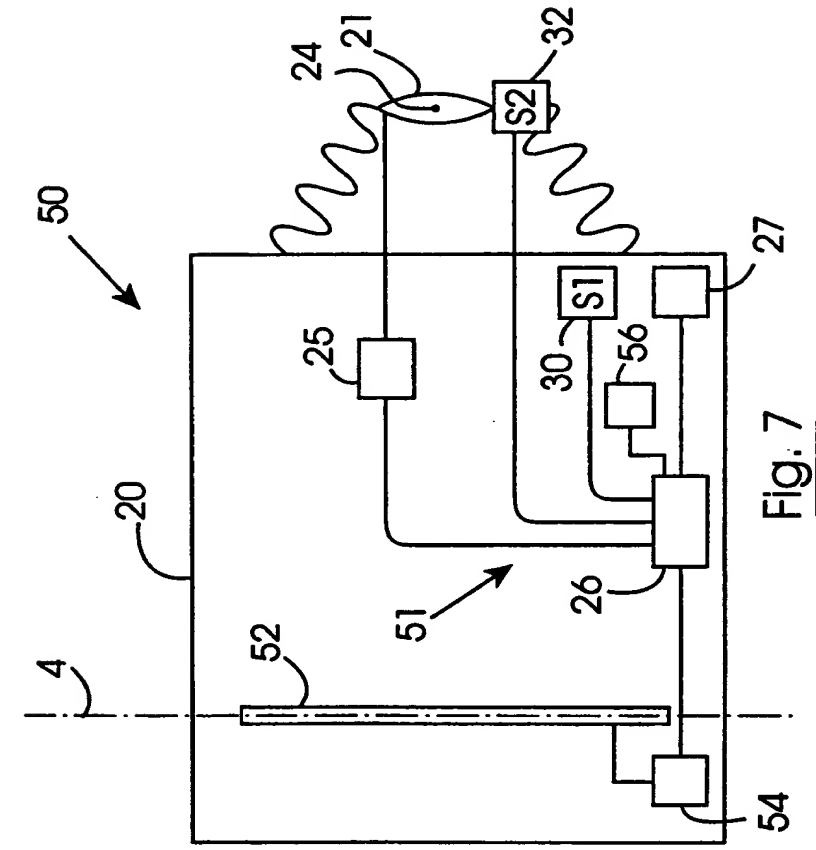


Fig. 7

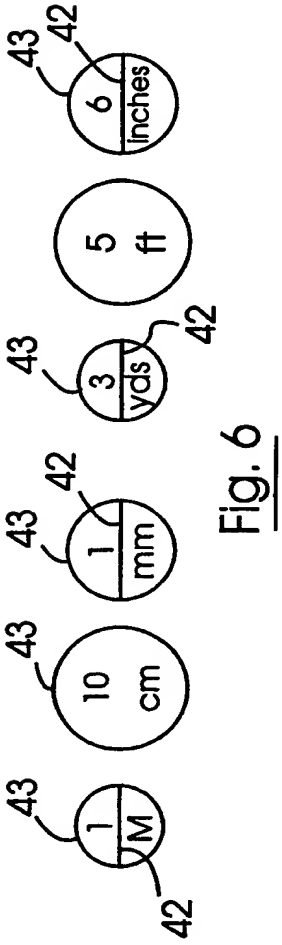


Fig. 6

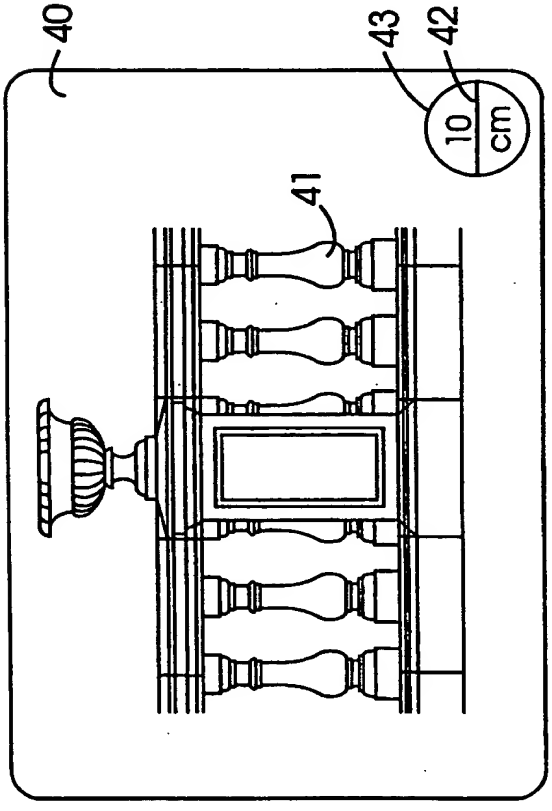


Fig. 5

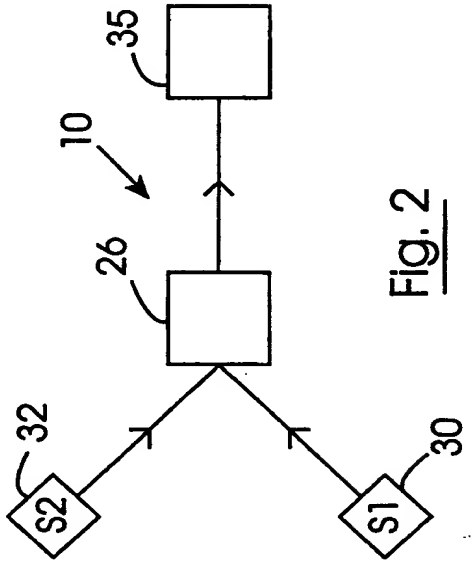


Fig. 2

# INTERNATIONAL SEARCH REPORT

Inter[redacted]l Application No
PCT/IE 00/00037

A. CLASSIFICATION OF SUBJECT MATTER
IPC 7 G01B11/00 G01B11/02 G03B17/24

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
IPC 7 G01B G03B

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

| Category * | Citation of document, with indication, where appropriate, of the relevant passages | Relevant to claim No. |
|---|---|---|
| P,X | US 5 937 213 A (MIYAMOTO HIDENORI ET AL)<br>10 August 1999 (1999-08-10)<br><br>abstract; figures 1A-5 | 1-4,24,<br>25,<br>47-50,<br>101-105 |
| P,Y | | 10-15,<br>56,57 |
| X | & JP 06 194733 A (NIKON CORP)<br>15 July 1994 (1994-07-15) | 1-4,24,<br>25,<br>47-50,<br>101-105 |
| Y | | 10-15,<br>56,57 |
| X | & JP 07 295064 A (NIKON CORP)<br>10 November 1995 (1995-11-10) | 1-4,24,<br>25,<br>47-50,<br>101-105 |
| Y | | 10-15,<br>56,57 |

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[X] Further documents are listed in the continuation of box C.

[X] Patent family members are listed in annex.

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"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

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"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.

"&" document member of the same patent family

| Date of the actual completion of the international search | Date of mailing of the international search report |
|---|---|
| 2 June 2000 | 13/06/2000 |

| Name and mailing address of the ISA | Authorized officer |
|---|---|
| European Patent Office, P.B. 5818 Patentlaan 2<br>NL – 2280 HV Rijswijk<br>Tel. (+31–70) 340–2040, Tx. 31 651 epo nl,<br>Fax: (+31–70) 340–3016 | Vorropoulos, G |

Form PCT/ISA/210 (second sheet) (July 1992)

# INTERNATIONAL SEARCH REPORT

Inter[redacted]l Application No
PCT/IE 00/00037

C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT

| Category * | Citation of document, with indication,where appropriate, of the relevant passages | Relevant to claim No. |
|---|---|---|
| Y | EP 0 725 292 A (ASAHI OPTICAL CO LTD)<br>7 August 1996 (1996-08-07)<br>abstract<br>page 8 -page 11; figures 6,7 | 10-15,<br>56,57 |

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Information on patent family members

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PCT/IE 00/00037

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